AN ANALYSIS OF EFFICIENCY AND EFFECTIVENESS OF PUBLIC SPENDING ON HEALTH SECTOR IN SUB-SAHARAN AFRICAN (SSA) COUNTRIES

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ABSTRACT
This paper examined the efficiency and effectiveness of public health spending in a sample of 46 SSA countries over 2000-2010 and 2011-2022 periods. The study employed Data Envelopment Analysis (DEA), Tobit regression, Simar-Wilson Bootstrap (algorithm #1) and cross-sectional regression. The main results revealed that: (i) average SSA countries public health spending efficiency scores were 0.857 and 0.900 in the two periods. (ii) Cape Verde and Seychelles were consistently efficient and (iii) average public health spending efficiency scores were virtually the same across income level, resource abundance, conflict and fragile as well as colonial legacy countries groupings. The study argued that the region could have achieved about 14% and 10% more additional health outcomes while using same amount of resources. The study, therefore, suggested that better public health care outcomes could be achieved in SSA by improving health sector regulatory framework, guided urbanization growth as well as strengthening HIV-AIDS, malaria and obesity control effort.
Keywords: *Efficiency, effectiveness, public health spending*
JEL Classification: *C14, C34, H51*

1. Introduction
Adequate health care delivery guarantees healthier population and decrease the rate of human capital depreciation (Beraldo et al., 2009; Streeten, 1994). A healthy and productive labour force can propel productivity and income growth as well as establish the basis for country prosperity and improved living standard. Consequently, the quantity and quality of public health spending has continued to receive the attention of researchers and policy makers globally.

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Public health spending and outcomes witnessed modest improvement in most SSA countries over 2000-2020 periods. Average spending as share of GDP increased marginally to 1.86% in 2010-2020 from about 1.74% during 2000-2009. However, the region commits less public resource to health when compared to a combined average of about 4.02% and 4.58% recorded by East Asia and Pacific (EAP), Europe and Central Asia (ECA), Latin America and Caribbean (LAC) as well as Middle East and North Africa (MENA). Likewise, SSA average infant and under-five mortality rates declined from 78.84 to 57.89 and 127.51 to 87. Maternal mortality rate felled from 727.3 to 591.91 and life expectancy increased from 53.41 to 59.40. Nevertheless, average infant and under-five mortality rates recorded more impressive declined from 22.42 to 14.70 and 27.41 to 21.03 in other developing regions (WDI, 2023).

The foregoing discussion pointed to enduring gap between SSA public health spending and outcomes compared to the rest of the world. In addition, the region failed to allocate a minimum of 5% of GDP to health care for seamless achievement of universal health care coverage (Mcintyre et al., 2017). Furthermore, covid-19 debt legacy, cost of living crisis and weak commodity demand have weakened the capacity of many SSA countries to mobilize additional resources needed to finance ever increasing health care demand. Thus, improving efficiency and effectiveness in the use of available resource is most paramount. Many previous studies attempted to measure the efficiency and effectiveness of public health spending in developed countries (Afonso et al., 2023; Antonelli & De Bonis, 2019; Gavurova et al., 2017). Nonetheless, the literature is gradually evolving in Africa. The few studies peculiar to Africa exclude many countries and covered 1984-2020 periods (Adegboye & Akinyele, 2022; Gupta & Verhoeven, 2001; Koku, 2015; Wandeda, 2021a). The contributions of the current paper include: (i) estimating public health spending efficiency scores for 46 SSA countries (ii) undertook formal analysis of mean difference in efficiency scores among SSA countries' grouping (income level, resources abundances, fragile and conflict status and colonial legacies) and (iii) identify the determinants of efficiency and effectiveness of public health spending in SSA countries.

To achieve these objectives, this paper has been structured into five sections with the introduction as section one. Section two is the literature review while section three discusses the methodology of the paper. Section four is the result presentation and discussion. Section five is the concluding remark and policy recommendation of the paper.

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2. Literature Review

2.1 Conceptual Review

Efficiency is conceptualized as the optimal utilization of resources in production. This involves either achieving maximum possible amount of output from a given input or using the least possible amount of input to produce a given output (Avkiran, 2006; Koku, 2015; Koopmans, 1951; Lovell, 1993). While, Effectiveness refers to the extent to which the socially desired outcome or objectives are achieve from the use of the available resources (European Commission EC, 2007; Herrmann et al., 2008; Productivity Commission PC, 2013). Thus, public spending is efficient and effective, if the inputs (entries) produced maximum attainable outputs (results) and the results lead to socially desirable outcomes or effects (Mandl et al., 2008).

2.2 Theoretical Review

Production theory provides suitable framework for assessing the relationship between inputs and output. Built upon the work of Wicksteed (1894) the theory formalised the technical relationship between inputs and outputs of a production entity for a given state of technology (Heathfield, 1976; Humphrey, 1997; Sarri, 2011; Shephard, 2015). For instance, governments can be viewed as producers engaged in the production of different outputs by combining labour with other inputs. It's built and maintains medical facilities, train and employ medical personnel as well as procure drugs and medical equipment to increase their populations' life expectancy. Governments that achieve better result while spending less on inputs can be viewed as more efficient than governments that achieve less results and use more resource, other things being equal"(Gupta & Verhoeven, 2001).

2.3 Empirical Review

For brevity, Table 1 summarized relevant literature on "efficiency and effectiveness" of public health spending. This paper differs from existing studies in at least three ways (i) in addition to calculating the technical efficiency score; an analysis of the mean difference in efficiency scores across income level, resources endowment, conflict and fragility and colonial legacy was carried out (ii) include more countries (46) as well as extend the sample period up to 2022 (iii) assess the effectiveness of public health spending on the basis of broader conceptualization (relationship between input and outcomes).

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Table 1: Empirical literature on Efficiency and Effectiveness of public Health spending

Author(s)	Country(ies) /Period	Input(s)/Output(s)	Method/ Model	Major Findings
Afonso *et al.,* (2021)	18 OECD economies; 2006–2017	Input: Public Expenditure (PE) as (%) of GDP output: Public Sector Performance, (PSP) index.	DEA and Simar-Wilson second stage regression.	Average efficiency scores range between (0.6-0.7); PIT significantly reduce public sector efficiency, and improved tax base raise efficiency level.
Ouertani *et al.*,(2018)	Saudi Arabia's 1988–2013	Inputs: public expenditure on education, health and infrastructure output: primary/ secondary school enrolment, infant mortality and life expectancy, electricity power transmission, energy consumption per capita and telephone per 100 habits for infrastructure.	DEA-Bootstrap analysis	The study discovered average efficiency scores of about (0.507), implying the existences of about (0.497) room for efficiency improvements in resource utilization.
Liu *et al.,* (2019)	Rural China; 2007 to 2016	Inputs: healthcare expenditure per capita (PPP) and total expenditure on health as (%) of GDP) Output: Principal Component Analysis was used to aggregate the output.	Using super-slack-based measure (SBM) model with the Malmquist productivity index (MPI)	Static and dynamic health care efficiency scores average at about (0.598) and (0.949); technological progress and scale optimization were found to be the main factors hindering total factor productivity (TFP) growth.
Gupta and Verhoeven (2001)	38 African countries; 1984-1995	Inputs: Per capita education and health spending. output: primary/secondary school enrolment, adult illiteracy, life expectancy, infant mortality and immunization against measles and diphtheria-pertussis-tetanus (DPT)	FDH technique	Best practice countries include: Gambia, Guinea, Ethiopia and Lesotho while, Botswana, Cameroon, Cote d"Ivoire and Kenya were relatively less efficient. In addition, countries in Asia and the western hemisphere seem to perform better in education and health compared to Africa.

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Table 1 (Continued)

Author(s)	Country(ies) /Period	Input(s)/Output(s)	Method/ Model	Major Findings
Olanubi and Osode (2017)	Nigeria; 1966-2014	Input: public recurrent health expenditure as (%) of total government recurrent expenditure output: life expectancy.	Stochastic frontier analysis (SFA)	On the average, different regimes in Nigeria wasted roughly 38.55% of the funds allocated to human resource.
Olanubi and Olanubi (2023)	29 SSA countries; 1998−2002, 2003−07, 2008−12, 2013−17	Inputs: government education and health expenditure Output: Public Sector Performance (PSP) index.	Stochastic frontier analysis (SFA)	Average efficiency score for the entire sample was about (0.794). South Africa has the highest efficiency score (0.93) and Niger had the lowest efficiency score (0.69). In addition, corruption has insignificant effect on efficiency, but quality bureaucracy matters for efficiency improvement in SSA.
Eneji *et al.* (2013)	Nigeria; 1999-2012	Health expenditure, health status and productivity	Multiple regression analysis	The results indicated a weak association between health expenditure, health status and productivity in Nigeria.
Ohikhuare *et al.* (2022)	15 West Africa countries; 1992 to 2020	Public health investment; human capital accumulation; financial opportunities and labour productivity	Panel ARDL	Human capital stock supplement financial opportunity positively and significantly increases labour productivity in the short and long run, in addition, human capital accumulation augmented with public spending on health and public investment in health have a positive effect in the long run and the short run.

Source: Authors' compilation (2025)

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3. Data and Methodology

Table 2: Description and Measurement of Variables

Variables	Abbreviation	Description and Measurement	Sources	References
Public spending on Health as % of GDP	*HE*	Public expenditure on health from domestic sources.	WDI	(Ouertani et al., 2018; Wandeda, 2021a)
		Outputs		
Infant survival rate	*IS*	Survival rate, infant (per 1,000 live births).	WDI	(Mohanty & Bhanumurthy, 2018; Ouertani et al., 2018; Wandeda, 2021a)
Life Expectancy	*LE*	Number of years a new-born infant would live if mortality patterns at the time of its birth were to stay the same.	WDI	(Mohanty & Bhanumurthy, 2018; Ouertani et al., 2018; Wandeda, 2021a)
		Outcomes		
Human development index	*HDI*	A composite index measuring average achievement in education, health and income level.	UNDP/ HDR	(Adegboye & Akinyele, 2022; Prasetyo & Zuhdi, 2013)
Health Life Expectancy at Birth	*HALE*	Average number of years that a person can expect to live in "full health".	WHO	(Ahmed et al., 2019)
		Socio-economic and Environmental Variables		
Mean Years of Schooling	*MYS*	Average number of years of education received by people ages 25 and older.	UNDP/ HDR	(Afonso & St. Aubyn, 2011; Antonelli & De Bonis, 2019; Evans et al., 2000)
Incidence of malaria	*MAL*	Estimated malaria incidence (per 1000 population at risk)	WHO	(Kabongo & Mbonigaba, 2024)
HIV-AIDS prevalence	*HIV*	Prevalence of HIV among adults aged 15 to 49 (%).	WHO	(Hauner & Kyobe, 2010)
Prevalence of obesity	*OBESITY*	Prevalence of obesity among adults, BMI & Greater Equal; 30 (crude estimate) (%)	WHO	(Afonso & St. Aubyn, 2011)
Regulatory quality	*REGQ*	World Bank regulatory quality index (-2.5 to 2.5)	WDI	(Wandeda, 2021a)
Control of corruption	*COR*	World Bank control of corruption index (-2.5 to 2.5)	WDI	(Olanubi & Olanubi, 2023)
Urbanization	*UR*	Urban population refers to % of people living in urban areas	WDI	(Herrera & Pang, 2005; Wang & Tao, 2019)

Source: Authors' compilation (2025)

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3.1 Data

The data for a sample of 46 SSA from 2000-2022 was summarized in Table 2. We split the sample period into two 2000-2010 and 2011-2022 such that the variables averages were used for analysis. The philosophy for choosing this design was informed by the existence of gap between public health spending and resultant outcomes. Moreover, averaging the data reduces the challenge of missing data (Agasisti, 2014). Similar setting was employed in many past studies (Afonso & Aubyn, 2005; Agasisti, 2014; Gupta & Verhoeven, 2001; Mohanty & Bhanumurthy, 2018). Furthermore, in line with Afonso and Aubyn, (2006) as well as Mohanty and Bhanumurthy, (2018) "infant mortality rate" IM was transformed to "infant survival rate" IS using equation (1). This is because having "more output is better".

$$IS = \frac{1000-IM}{IM} \qquad 1$$

3.2 Analytical Techniques

Measurement of Efficiency: The DEA Estimation Approach

This study utilized the output-oriented DEA models under variable return to scale, because SSA countries are lagged behind in terms of public health spending and outcomes. Thus, having more spending is preferred to less. The origin and development of DEA model was associated with the works of (Banker et al., 1984; Charnes et al., 1978; Farrell, 1957). The output-oriented model measures efficiency from the perspective of raising the level of outputs by a given DMUs without using additional inputs. Assume there are N observed DMUs (here countries) N = 1, 2… 46; each utilizing different amounts of M inputs to attain different amounts of S outputs; DMU_n employs x_{in} amount of input i, i = 1… M to produce y_{rn} amount of output r, r = 1,… ,S. The formalisation of output-oriented DEA technique is outline as follows:

$$\emptyset^* = max\emptyset$$

Subject to:

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq xio; \qquad i = 1,2,\ldots\ldots,m$$

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq \emptyset yro; \qquad r = 1,2,\ldots\ldots,s$$

$$\sum_{j=1}^{n} \lambda_j = 1 \ (VRS)$$

$$\lambda_j \geq 0; \qquad j = 1,2,\ldots\ldots,n \qquad 2$$

Where, DMU_0 represents one of the n countries (DMUs) under investigation; x_{io} and y_{ro} are the $i-th$ input and $r-th$ output for DMU_0 respectively. The efficiency score of DMU_0 is represented by $\emptyset^*$. DMU_0 is efficient if $\emptyset^* = 1$. However, if $\emptyset^* > 1$, then it is inefficient. Next, we test the mean difference in average efficiency scores among income level, resources abundance, conflict and fragile as well as colonial legacy SSA countries grouping using Mann Whitney U and Kolmogorov-Smirnov Tests. These tests are handy in analysing efficiency scores because they are distribution free and robust even in a small sample (Pappas & DePuy, 2004).

Modelling the Determinants of efficiency and Effectiveness in of Public Health Spending in SSA

Equation (3) represents the second stage regression model used to examine the exogenous factors that determine the level of public health spending efficiency in SSA.

$$\emptyset_i = \beta z_i + \varepsilon_i \qquad i = 1, 2 \ldots\ldots\ldots\ldots 47 \qquad 3$$

Where $\emptyset_i$ is (46x1) vector of DEA efficiency scores estimated in the first stage; z_i is a (1 x s) vector of nondiscretionary variables; β is the (s x 1) vector of coefficients to be estimated and ε_i is the (46x1) error vectors. The error terms are assumed to be normally distributed with zero mean (μ) and constant standard deviation (σ). To ensure robust results Equation (3) was estimated using Simar and Wilson (2007) bootstrap (algorithm #1) and censored Tobit regression. These approaches were justified since the distribution of the efficiency scores are not normal (i.e. are bounded between 0 and 1). The censoring point is set at zero, such that the efficient DMUs will have a score of zero, and the inefficient DMUs will have score greater than zero. The transformation of the output oriented model VRS technical efficiency score to technical inefficiency was done in line with (Ahmed et al., 2019) as follows:

$$inefficiency = \left(\frac{1}{efficiency\ score}\right) - 1 \qquad 4$$

The non-discretionary factors carefully chosen on the basis of past literature as determinants of efficiency in SSA public health spending includes: malaria incidence *MAL* (Kabongo & Mbonigaba, 2024), HIV-AIDS incidence (Hauner & Kyobe, 2010), obesity (Afonso & St. Aubyn, 2011), urbanisation *UR* (Sikayena et al., 2022) and control of corruption *COR* (Koku, 2015). Arising from equation (4) the Tobit model can be described in terms of a latent dependent variable and econometrics forms in equation (5) and (6) as follows:

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$$inefficiency\begin{cases} 0 & ineff \le 0; i = 1,....4 \\ ineff_i^* & ineff > 0;\ i = 5,....46 \end{cases} \quad \mu_i \neg IIDN\left(0, \sigma^2\right) \qquad 5$$

$$INEFFHE = \gamma_o + \gamma_1 lMAL_i + \gamma_2 lHIV_i + \gamma_3 lOBESITY_i + \gamma_4 lUR_i + \gamma_5 COR_i + \omega \qquad 6$$

Where $0 \le ineffhe \le 1; i = 1,2,...46; m = 1,2,...n$; $ineffhe$ is the dependent variable $(\gamma_i)_i$, is the model coefficients, l is the natural logarithms sign, (ω) is the model error term. Moreover, the Simar and Wilson (2007) first algorithms procedures was implemented using STATA V.17. To draw better inference the study used adequate number of bootstrap estimates (i.e. L=3000) in simarwilson command on the basis of externally estimated DEA scores (algorithm #1). Moreover, human development index and healthy life expectancy at birth were considered as the overall desired health care investment outcomes (Aubyn et al., 2009; Davies, 2009; Martins & Veiga, 2014; Prasetyo & Zuhdi, 2013; Stiefel et al., 2010) . On the basis of the foregoing discussion and insight from Aubyn et al., (2009) a model that assessed the effectiveness of public health spending was specified as follows:

$$lY_i = \gamma_0 + \gamma_1 lHE_i + \gamma_2 \phi_i + \gamma_3 REGQ_i + \gamma_4 lHIV_i + \gamma_5 lMYS_i + \nu_i \qquad 7$$

Where Y_i is country i desired health sectors investment outcomes (human development index and healthy life expectancy at birth); HE_i represents public health spending as % of GDP for country i; $\emptyset i$ is the estimated efficiency scores for country i; $REGQ_i$ is regulatory quality in country *i*; HIV_i is incidence of HIV-AIDS in country *i*; MYS_i is the mean years of schooling in country *i*; v_i is the model error term and l is the natural logarithms sign. Equation (7) was estimated using a robust OLS that corrects standard errors for heteroscedasticity.

4. Results and Discussion

4.1 Descriptive Statistics and Correlation Analysis

Table 3 Panel "A" presents summary statistics for 2000-2010 and 2011-2022 sub periods. Results indicated that average *HE* slightly increased from 1.60 to 1.64 while that of *IS* markedly rose from 16.48 to 23.35. Also, noticeable volatility existed on *HE* and *IS* as evidenced by their respective standard deviation *HE* 1.03 and 1.17 and *IS* 11.30 and 13.41. The minimum values of *HE* 0.22 and 0.15 and *IS* 7.21 and 10.10 as well as the maximum values of *HE* 4.56 and 5.21 and *IS* 81.90 and 79.72 are evidence of improve public resources allocation to health sector and infant survival rates in SSA. Again, result indicated a rise in life expectancy at birth as manifested by the change in mean of *le* from (55.37 to 61.28), the standard

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deviation decreased from (5.88 to 4.82) the minimum values stand at (44.36 and 51.42) the maximum values are (72.52 and 75.15). Table 3 Panel "B" suggests varying degree of socio-economic status among SSA countries due to noticeable difference between the maximum and minimum values for each variable and the deviation of each variable from the sample mean. For instance, the standard deviation of *HDI* is 0.63; *HALE*, 4.31; *MYS*, 2.18; *UR*, 17.65; *MAL*, 137.98; *HIV*, 6.66; obesity, 4.10; *COR*, 0.64 and *REGQ*, 0.53 are quite apart from their respective means for *HDI*, 0.62; *HALE*, 52.26; *MYS*, 5.15; *UR*, 42.46; *MAL*, 9197.16; *HIV*, 4.82, obesity, 7.59, *COR* -0.63) and *REGQ*, -0.714.

Table 3: Summary Statistics of the Variables (Pooled)

Panel A: Inputs and Output Variables								
Variables	**Mean**		**Std. Dev.**		**Min**		**Max**	
	2010	**2022**	**2010**	**2022**	**2010**	**2022**	**2010**	**2022**
HE	1.602	1.637	1.029	1.166	0.216	0.453	4.564	5.213
IS	16.481	23.350	11.385	13.408	7.211	10.101	81.902	79.718
LE	55.367	61.280	5.879	4.819	44.357	51.423	72.522	75.145

Panel B: Socio-economic Variables				
Variables (2022)	**Mean**	**Std. Dev.**	**Min**	**Max**
HDI	0.619	0.632	0.381	0.791
HALE	52.258	4.311	42.325	64.125
MYS	5.150	2.175	1.600	10.478
UR	42.463	17.646	12.593	88.629
MAL	197.159	137.982	1.243	422.485
HIV	4.822	6.664	0.100	28.531
OBESITY	7.597	4.101	3.114	25.143
COR	-0.628	0.640	-1.489	0.936
REGQ	-0.714	0.534	-2.178	0.623

Source: Authors' computation (2025)

Table 4 Panel "A" results show positive association between the input and outputs *HE* and *IS* 0.475, *HE* and *MS* 0.294 and *HE* and *LE* 0.216, this suggested increasing inputs will not lead to a reduction in output level and meet the requirement of isotonicity property of DEA. Also, the outputs are not strongly correlated (i.e., $r^2 < 80$) except between *IS* and *LE* 0.809. Furthermore, due to obvious week association among all the variables (i.e., $r^2 < 80$), Table 4 Panel "B" results rule out the problems of multicollinearity among the independent variables.

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Table 4: Correlation Coefficients among the Variables

Panel A: Inputs and Outputs Variables

Variables	*HE*	*IS*	*LE*
HE	1.000		
IS	0.475	1.000	
LE	0.216	0.809	1.000

Panel B: Socio-economic Variables

Variables	*HDI*	*MYS*	*UR*	*COR*	*REGQ*	*HALE*	*MAL*	*Obesity*	*HIV*
HDI	1.000								
MYS	0.335	1.000							
UR	0.010	0.532	1.000						
COR	-0.09	0.347	0.182	1.000					
REGQ	-0.20	0.306	0.117	0.797	1.000				
HALE	0.478	0.224	0.312	0.462	0.257	1.00			
MAL	-0.28	-0.42	-0.143	-0.317	-0.11	-0.32	1.000		
Obesity	0.322	0.724	0.507	0.424	0.405	0.07	-0.482	1.000	
HIV	0.394	0.459	0.005	0.368	0.435	-0.53	-0.373	0.609	1.000

Source: Authors' computation (2025)

4.2 Efficiency of Public Spending on Health in SSA

Table 5 indicated that five countries were efficient in public health spending during 2000-2010, namely: Cape Verde, Congo Democratic Republic, Equatorial Guinea, Mauritania and Seychelles. Two of the efficient countries Cape Verde 3.04 and Seychelles 3.38 allocated more than sample average public health spending 1.602 and have achieved twice the sample average 16.48 in infant survival rate, Cape Verde 39.74, Seychelles 87.90. Also, their recorded life expectancy at birth Cape Verde 71.78, Seychelles 72.52 are significantly greater than the sample average 55.37. The other three efficient countries spent less than half the sample average 0.80: Congo Democratic Republic 0.22, Equatorial Guinea 0.28 and Mauritania 0.74, but achieved more than half the sample average in infant survival rate 8.24: Congo Democratic Republic 9.53, Equatorial Guinea 9.84 and Mauritania 19.00 as well as recorded above the sample average life expectancy at birth: especially in Equatorial Guinea 55.55 and Mauritania 61.86. Additionally, four countries were efficient during 2011-2022 period, Cape Verde and Seychelles maintained their previous performance, the new efficient countries spend less than half the sample average 0.82, Cameroon 0.45 and Eritrea 0.76 but achieved more than the sample average in infant survival rate and life expectancy at birth Eritrea (29.30; 66.08) and close to sample average as in Cameroon (17.12; 59.72). Some authors also reported that Cape Verde and Seychelles public health sector spending were efficiently managed (Kirigia et al., 2008; Koku, 2015; Novignon & Lawanson, 2017). This is not surprising; the two countries have outperformed their African peers in terms of infant survival rate and life expectancy (World Health Organization [WHO], 2024a, 2024b).

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Table 5: Efficiency Scores (2000-2010) and (2011-2022)

Countries	Coefficient		Ranking		Countries	Coefficient		Ranking	
	2010	2022	2010	2022		2010	2022	2010	2022
Angola	0.779	0.889	35	26	Liberia	0.905	0.888	19	27
Benin	0.930	0.925	14	19	Madagascar	0.911	0.928	17	17
Botswana	0.743	0.846	39	38	Malawi	0.811	0.889	30	24
Burkina	0.831	0.835	27	41	Mali	0.848	0.871	25	32
Burundi	0.788	0.836	33	40	Mauritania	1.000	0.953	1	12
Cabo Verde	1.000	1.000	1	1	Mozambique	0.808	0.840	31	39
Cameroon	0.900	1.000	20	1	Namibia	0.728	0.805	42	43
Central African Rep.	0.732	0.807	41	42	Niger	0.827	0.888	29	28
Chad	0.747	0.778	38	44	Nigeria	0.792	0.858	32	34
Comoros	0.987	0.971	6	7	Rwanda	0.860	0.910	23	23
Congo, Dem. Rep.	1.000	0.959	1	11	São Tomé & Príncipe	0.886	0.995	21	5
Congo, Rep.	0.971	0.941	8	16	Senegal	0.937	0.990	12	6
Côte d'Ivoire	0.879	0.869	22	33	Seychelles	1.000	1.000	1	1
Equatorial Guinea	1.000	0.965	1	8	Sierra Leone	0.742	0.856	40	35
Eritrea	0.935	1.000	13	1	South Africa	0.780	0.849	34	37
Eswatini	0.612	0.737	45	45	South Sudan		0.872		31
Ethiopia	0.840	0.961	26	10	Sudan	0.909	0.951	18	13
Gabon	0.970	0.942	9	15	Tanzania	0.852	0.945	24	14
Gambia, the	0.948	0.926	10	18	Togo	0.947	0.889	11	25
Ghana	0.924	0.914	15	22	Uganda	0.829	0.925	28	20
Guinea	0.974	0.922	7	21	Zambia	0.760	0.872	37	30
Guinea-Bissau	0.764	0.962	36	9	Zimbabwe	0.645	0.850	43	36
Kenya	0.914	0.884	16	29	**Average**	**0.857**	**0.900**		
Lesotho	0.616	0.684	44	46					

Source: Authors computation (2025)
NB: Input= public spending on health % of GDP, Output=infant survival rate and life expectancy

Furthermore, in 2024 Cape Verde was certified as third malaria free county in Africa (World Health Organization WHO, 2018, 2024c). These achievements were facilitated by strong political will, effective primary health care system PHCs and above all, good governances (Adam, 2018; Workie et al., 2018; World Health Organization WHO, 2019). Also, previous average health sector efficiency score reported in SSA include: 0.79 reported by (Olanubi & Olanubi, 2023) and 0.50 found by (Novignon, 2015). Also, Koku (2015) reported an average of 0.59 for ECOWAS countries, in Nigeria Olanubi and Osode (2017) reported an average of 0.62. The range of average health sector efficiency 0.29 reported in the literature is lower when compared with the range in this study 0.45. This is an indication that majority of the sampled SSA countries were not efficient.

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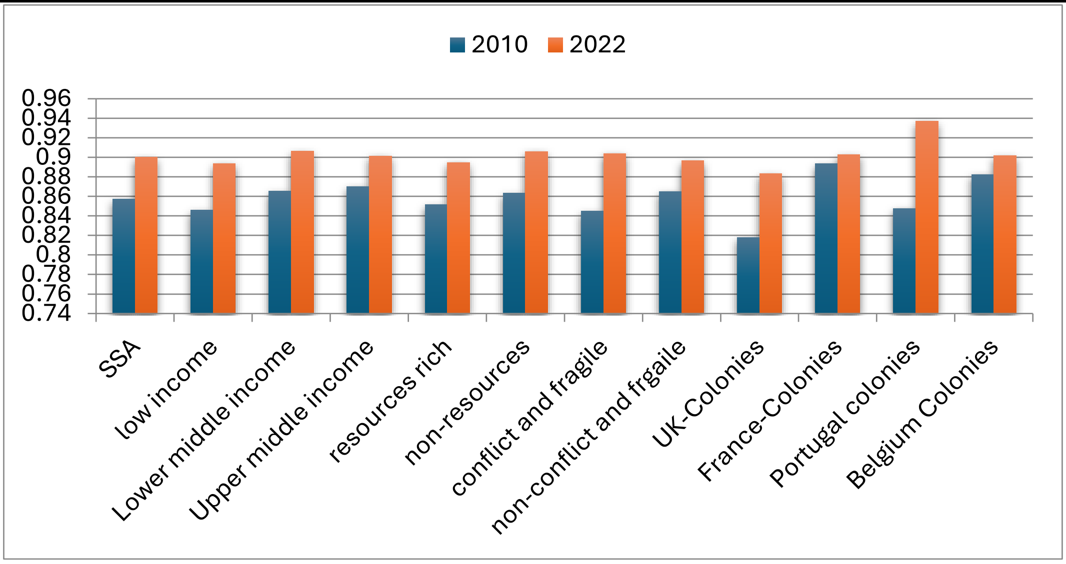

Figure 1: Average Health Output Models Efficiency Estimates
Source: Authors computation (2025)

Figure 1 compared the distribution of average efficiency scores among SSA countries grouping over 2010 and 2022 decades. There was noticeable increase across all countries grouping with the highest increased recorded in Portugal colonies from 0.85 to 0.94 and the lowest in French colonies from 0.89 to 0.90. Table 6 show the results of Mann Whitney U. and Kolmogorov-Smirnov tests of difference in average efficiency scores among SSA countries groups. Evidently, the observed difference over the two period was not statistically significant for all countries groups except between British and French colonies (z = -1.908, p-values = 0.056) at 10% significant level.

Table 6: Mean Difference in Health Efficiency across Countries Groups

Countries Grouping	Mann Whitney U Test		Kolmogorov-Smirnov Test	
	2000-2010	2011-2022	2000-2010	2011-2022
Lower versus Upper income	-0.279(0.780)	-0.156(0.876)	0.309(0.875)	0.309(0.875)
Resources Intensive Versus Non-Intensive	-0.663(0.507)	1.108(0.267)	0.196(0.777)	0.277(0.351)
Conflict and Fragile versus non conflict and fragile	-0.835(0.404)	-0.078(0.937)	0.218(0.662)	0.235(0.564)
Colonial Legacy	-1.908(0.056)	0.747(0.455)	0.400(0.181)	0.200(0.925)

Source: Authors computation (2025); NB: Values in () are P-values

4.3 Determinants of inefficiency in Public Spending on Health in SSA

Evidently, the incidence of malaria *MAL* is an important determinant of public health inefficiency in Table 7. For example, a 1% increase in the incidence of malaria will lead to an increase in health care inefficiency score by about 0.018 and 0.013 in Tobit and Bootstrap regression estimates. However, only the Tobit coefficient is statistically significant at 10% level of significant. Kabongo and Mbonigaba reported closely related evidence, the authors argued that malaria incidence was one of the channels through which government health expenditure affect disability adjusted life years in SSA. Again, WHO (2023) claims that African continent has the highest malaria burden with more than half global cases and malaria related death accounted by just four African countries in 2022.

Table 7: Determinants of in-efficiency in Public Spending on Health in SSA

Variables	Dependent Variable: Health inefficiency Score 2022			
	Tobit regression		Bootstrap (algorithm #1)	
	Coefficients	P-values	Coefficients	P-values
lMAL	0.018 (0.009)	0.058	0.013(0.011)	0.206
lHIV	0.019(0.009)	0.046	0.020(0.008)	0.017
lUR	-0.086(0.027)	0.004	-0.065(0.025)	0.008
lObesity	0.010(0.004)	0.027	0.007(0.004)	0.089
COR	0.007(0.021)	0.755	0.0003(0.019)	0.988
Costant	0.249(0.100)	0.018	0.799(0.089)	0.000
Observation	39		36	
Left-censored	3			
Uncensored	36			
Right-censored	0			
No. of bootstrap			3000	
Efficient DMUs	3		3	
Prob > chi2	0.0031		0.016	

NB: Values in () are Standard error.
Source: Authors' computation (2025)

Similarly, prevalence of HIV-AIDS significantly accelerates the in-efficiency in public health sector spending. For example, a 1% increase in the prevalence of HIV-AIDS can increase the health sector in-efficiency score by an average of about 0.019 and 0.020 in Tobit and Bootstrap regression estimates at 5% significant level. In line with *a-priori* expectation, these results further demonstrate that malaria and HIV-AIDS are important public health challenges that significantly impact health outcomes in SSA countries. Some authors also confirmed that HIV-AIDS prevalence increase health sector in-efficiency and is one of the reason for

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deterioration in health performance in many countries (Hauner & Kyobe, 2010; Herrera & Ouedraogo, 2018). A report by The Joint United Nations Programme on HIV-AIDS (UNAIDS) (2022) show that, HIV epidemic exerted significant impact on SSA countries, the continents accounted for about 67% of the 38.4 million people living with HIV (PLWH) globally in 2021. Also, SSA region is responsible for 670,000 of the 1.5 million new infections and 280,000 of the 650,000 AIDS-related deaths reported globally in 2021. The foregoing evidences implies that tackling malaria and HIV-AIDS epidemics can go a long way in promoting efficiency in SSA health sector and enhance health related development goals.

Furthermore, the rate of urbanisation proved to be important determinants of health sector in-efficiency in SSA countries. A 1% increase in urbanisation rate *UR* can decrease health sector in-efficiency score by about 0.086 and 0.065 in Tobit and Bootstrap regressions estimates at 1% level of significant respectively. This is similar to the findings reported by (Herrera & Ouedraogo, 2018; Loikkanen & Susiluoto, 2005; Ouertani et al., 2018). This supports the proposition that optimal health facilities and services are difficult to achieve if population are scatter in rural setting. Also, the result indicated that obesity is an important determinant of health sector in-efficiency in SSA countries. For example, a 1% increase in *lobesity* could increase health sector in-efficiency score by about 0.01 and 0.007 in Tobit and Bootstrap estimate at 5% and 10% significant level respectively. This evidence was earlier suggested by (Afonso & Aubyn, 2006b; Afonso & St. Aubyn, 2011). The World Health Organization WHO (2022) observed and reported an increasing trend of obesity in SSA countries particularly among children, teenagers and women of reproductive age. This suffices to suggest that taming the rising trend in obesity can help reduce in-efficiency in SSA countries public health sector.

Surprisingly, control of corruption is not a significant determinant of health sector in-efficiency score in SSA countries over the sample period studied. This results is however in stark contrast with the existing literature (Fonchamnyo & Sama, 2016; Hauner & Kyobe, 2010; Koku, 2015). However, a strand of political short termism literature argued that in-efficiency in SSA social spending is driven by the neglect of the sector by politician rather than by corruption because the sector outcomes has little impact on re-election chances (Olanubi & Olanubi, 2023).

4.4 Effectiveness of Public Spending on Health in SSA

The effectiveness of public health spending was measured by the extent to which public spending promotes healthy life expectancy at birth and human development index. Table 8 results suggested that public spending on health as share of GDP and health sector efficiency scores are significant determinants of healthy life expectancy at birth and human development index and ultimately effective utilization of public health sector resources. For instance, a 1% rise in public health

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spending *lHE22* can increase life expectancy at birth and human development index by about 2% and 0.027% at 1% significant level respectively. Also, a 1% increase in public health sector efficiency score *EFFH22* increase healthy life expectancy at birth and human development index by 38.5% and 0.49% at 1% significant level respectively. Past literature opined that public health spending strengthen health status, improve human development index and raise the aggregate welfare in the developing world (Gomanee, 2005; Greenidge & Stanford, 2007; Gupta et al., 2004; Haile & Niño-Zarazúa, 2018). This supports the idea that government spending alone without value for money cannot guarantees better development outcomes. This result agree with (Rajkumar & Swaroop, 2008) who argue that public health expenditure cannot guarantee better health outcomes without well-formulated, credible and properly executed budget.

Table 8: Determinants of Effectiveness in Public Spending on Health in SSA

Variables	DV: Healthy Life Expectancy at Birth		DV: Human Development Index	
	Coefficients	P-values	Coefficients	P-values
lHE22	2.002 (0.289)	0.000	0.027(0.006)	0.000
EFFH22	38.513(6.29)	0.000	0.493(0.093)	0.000
REGQ	2.077(0.493)	0.000	0.032(0.013)	0.022
lHIV	-0.478(0.073)	0.000	-0.0007(0.002)	0.672
lMYS	0.931(0.511)	0.077	0.119(0.015)	0.000
_cons	16.255(5.543)	0.006	-0.119(0.087)	0.180
Number of obs	42		42	
F(5, 36)	68.59		57.38	
Prob > F	0.0000		0.000	
R-squared	0.8721		0.8695	

NB: Values in () are Standard error.
Sources: Authors computation (2025)

Also, better regulatory quality promotes public health sector spending effectiveness by increasing healthy life expectancy at birth and human development index. For example, a 1% improvement in regulatory quality *REGQ* increase life expectancy and human development index by 2.1% and 0.032% at 1% and 5% significant level respectively. The result confirmed the evidence that public health expenditure produced better health outcomes when regulatory quality are sound (Wandeda, 2021b). This means good regulatory quality ensure production, procurement and utilization of quality drugs and supplies.

Additionally, the prevalence of HIV-AIDS decreases life expectancy at birth and human development index as well the effectiveness of public health sector

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spending. For instance, 1% increases in HIV-AIDS prevalence decrease healthy life expectancy at birth and human development index by 0.478% and 0.0007% respectively. The effect of *lHIV* on human development index was however not significant. Existing evidence suggested that AIDS lowers the disability adjusted life expectancy and depress the overall health related development indicators (Evans et al., 2000; Widner, 2015). This result attested to the increasing burden of HIV-AIDS in SSA countries. Finally, citizens' literacy rate enhances the effectiveness of public spending on health. For example, a 1% increase in mean years of schooling *lMYS* increase life expectancy at birth and human development index by 0.931% and 0.119% at 10% and 1% significant level respectively. This results agree with the assertion that schooling tend to benefit health outcomes and is an important ingredient for achieving overall development outcomes (Baldacci et al., 2003; Greenidge & Stanford, 2007; Gyimah-Brempong, 2011; Kabongo & Mbonigaba, 2024; Kabubo-Mariara et al., 2009; Silles, 2009). Overall, government health spending is more likely to be effective in well-educated and informed society.

5. Summary, Conclusion and Recommendation

5.1 Summary and Conclusion

This study investigated the efficiency and effectiveness of public health spending in a sample of 46 SSA countries over 2000-2010 and 2011-2022 periods. The analysis was conducted using DEA, Tobit regression, Simar-Wilson Bootstrap (algorithm #1) and cross-sectional regression analytical techniques. The primary findings of the study include: (i) average SSA countries public health spending efficiency scores were (0.857 and 0.900) in the two periods. (ii) Cape Verde and Seychelles were consistently efficient and (iii) average public health spending efficiency scores were virtually the same across different countries groupings. The study therefore submitted that, the region could have achieved about 14% and 10% more additional health outcomes while using same amount of resources. Additionally, better public health care outcomes could be achieved in SSA by improving health sector regulatory framework, guided urbanization growth as well as strengthening HIV-AIDS, malaria and obesity control effort.

5.2 Recommendation

The study therefore suggested that better public health care outcomes could be achieved in SSA by improving health sector regulatory framework, guided urbanization growth as well as strengthening HIV-AIDS, malaria and obesity control effort.

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REFERENCES

Adam, J.-P. (2018). The health sector in Seychelles: Prioritization and accountability. *Health Systems & Reform*, *4*(4), 277–278. https://doi.org/10.1080/23288604.2018.1514560

Adegboye, A., & Akinyele, O. D. (2022). Assessing the determinants of government spending efficiency in Africa. *Future Business Journal*, *8*(1), 47. https://doi.org/10.1186/s43093-022-00142-8

Afonso, A., & Aubyn, M. S. (2006a). Cross-country efficiency of secondary education provision: A semi-parametric analysis with non-discretionary inputs. *Economic Modelling*, *23*(3), 476–491. https://www.sciencedirect.com/science/article/pii/S0264999306000149

Afonso, A., & Aubyn, M. S. (2006b). *Relative efficiency of health provision: A DEA approach with non-discretionary inputs*. Department of Economics, ISEG-UTL.

Afonso, A., & Aubyn, M. St. (2005). Non-Parametric Approaches to Education and Health Efficiency in OECD Countries. *Journal of Applied Economics*, *8*(2), 227–246. https://doi.org/10.1080/15140326.2005.12040626

Afonso, A., & Fernandes, S. (2008). Assessing and explaining the relative efficiency of local government. *The Journal of Socio-Economics*, *37*(5), 1946–1979. https://www.sciencedirect.com/science/article/pii/S105353570700073X

Afonso, A., Jalles, J. T., & Venâncio, A. (2021). Structural Tax Reforms and Public Spending Efficiency. *Open Economies Review*, *32*(5), 1017–1061. https://doi.org/10.1007/s11079-021-09644-4

Afonso, A., Jalles, J. T., & Venâncio, A. (2023). Government spending efficiency, measurement and applications: A cross-country efficiency dataset. In *Handbook on Public Sector Efficiency* (pp. 44–71). Edward Elgar Publishing.

Afonso, A., Schuknecht, L., & Tanzi, V. (2005). Public sector efficiency: An international comparison. *Public Choice*, *123*(3–4), 321–347. https://doi.org/10.1007/s11127-005-7165-2

Afonso, A., & St. Aubyn, M. (2011). Assessing health efficiency across countries with a two-step and bootstrap analysis. *Applied Economics Letters*, *18*(15), 1427–1430. https://doi.org/10.1080/13504851.2010.541149

Agasisti, T. (2014). The Efficiency of Public Spending on Education: An empirical comparison of EU countries. *European Journal of Education*, *49*(4), 543–557. https://doi.org/10.1111/ejed.12069

Ahmed, S., Hasan, Z. M., Maclennan, M., Dorin, F., Ahmed, W. M., Hasan, M. M., Hasan, M. S., Isalm, T. M., & Khan, J. A. (2019). Measuring the efficiency

JJSS Volume 2, Number 1 (May, 2025)

of health systems in Asia: A data envelopment analysis. *BMJ Open*, 1–12. http:// dx. doi. org/ 10. 1136/ bmjopen- 2018- 022155).

Antonelli, M. A., & De Bonis, V. (2019). The efficiency of social public expenditure in European countries: A two-stage analysis. *Applied Economics*, *51*(1), 47–60. https://doi.org/10.1080/00036846.2018.1489522

Aubyn, M., Pina, A., Garcia, F., & Pais, J. (2009). *Study on the efficiency and effectiveness of public spending on tertiary education Third report (second draft)*. European Commission-Directorate-General for Economic and Financial Affairs. https://www.repository.utl.pt/handle/10400.5/25846.

Avkiran, N. K. (2006). Developing foreign bank efficiency models for DEA grounded in finance theory. Socio-Economic Planning Sciences, 40(4), 275–296. https://doi.org/10.1016/j.seps.2004.10.006

Baldacci, E., Guin-Siu, M. T., & Mello, L. D. (2003). More on the effectiveness of public spending on health care and education: A covariance structure model. *Journal of International Development*, *15*(6), 709–725. https://doi.org/10.1002/jid.1025

Banker, R., Charnes, A., & Cooper, W. W. (1984). Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis. *Management Science*, *30*(9), 1078–1092. https://doi.org/10.1287/mnsc.30.9.1078

Batare, S. (2012). Efficiency of public spending on education. *Viešoji Politika Ir Administravimas= Public Policy and Administration*, *11*(2), 171–186. https://cris.mruni.eu/cris/handle/007/10769

Beraldo, S., Montolio, D., & Turati, G. (2009). Healthy, educated and wealthy: A primer on the impact of public and private welfare expenditures on economic growth. *The Journal of Socio-Economics*, *38*(6), 946–956. https://www.sciencedirect.com/science/article/pii/S1053535709000791

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, *2*(6), 429–444. https://sci-hub.se/https://doi.org/10.1016/0377-2217(78)90138-8

Clements, B. (2002). How efficient is education spending in Europe. *European Review of Economics and Finance*, *1*(1), 3–26.

Davies, A. (2009). Human development and the optimal size of government—ScienceDirect. *The Journal of Socio-Economics*, *38*(2), 326–330. https://doi.org/10.1016/j.socec.2008.07.015

Eneji, M. A., Dickson, V. J., & Onabe, B. J. (2013). *Health care expenditure, health status and national productivity in Nigeria (1999-2012)*. https://irepos.unijos.edu.ng/jspui/handle/123456789/1741

 JJSS Volume 2, Number 1 (May, 2025)

European Commission EC. (2007). *Efficiency and Effectiveness of Social Spending. Achievements and challenges. Background note for the informal ECOFIN of 4-*.

Evans, D. B., Tandon, A., Murray, C. J., & Lauer, J. A. (2000). The comparative efficiency of national health systems in producing health: An analysis of 191 countries. *World Health Organization*, *29*(29), 1–36. http://people.stern.nyu.edu/wgreene/Statistics/Sicko/WHO-DALE-Study-29.pdf

Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society Series A: Statistics in Society*, *120*(3), 253–281. https://academic.oup.com/jrsssa/article-abstract/120/3/253/7101561

Fonchamnyo, D. C., & Sama, M. C. (2016). Determinants of public spending efficiency in education and health: Evidence from selected CEMAC countries. *Journal of Economics and Finance*, *40*(1), 199–210. https://doi.org/10.1007/s12197-014-9310-6

Gavurova, B., Kocisova, K., Belas, L., & Krajcik, V. (2017). Relative efficiency of government expenditure on secondary education. *Journal of International Studies*, *10*(2), 329–343. https://doi.org/doi:10.14254/2071-8330.2017/10-2/23

Gomanee, K. (2005). Aid, public spending, and welfare: Evidence from quantile regressions. *Journal of International Development*, *17*, 299–309.

Greenidge, K., & Stanford, S. (2007). *What are the determinants of the health status in Latin America and the Caribbean*. Central Bank of Barbados.

Gupta, S., Clements, B., & Inchauste, G. (Eds.). (2004). *Helping countries develop: The role of fiscal policy*. International Monetary Fund.

Gupta, S., & Verhoeven, M. (2001). The efficiency of government expenditure: Experiences from Africa. *Journal of Policy Modeling*, *23*(4), 433–467. https://doi.org/10.1016/S0161-8938(00)00036-3

Gyimah-Brempong, K. (2011). Education and economic development in Africa. *African Development Review*, *23*(2).

Haile, F., & Niño-Zarazúa, M. (2018). Does Social Spending Improve Welfare in Low-income and Middle-income Countries? *Journal of International Development*, *30*(3), 367–398. https://doi.org/10.1002/jid.3326

Hauner, & Kyobe, A. (2010). Determinants of Government Efficiency. *World Development*, *38*(11), 1527-1542,. https://doi.org/doi:10.1016/j.worlddev.2010.04.004

Heathfield, D. F. (1976). Production Functions. In D. F. Heathfield (Ed.), *Topics in Applied Macroeconomics* (pp. 33–68). Macmillan Education UK. https://doi.org/10.1007/978-1-349-86197-2_2

JJSS Volume 2, Number 1 (May, 2025)

Herrera, S., & Ouedraogo, A. (2018). *Efficiency of public spending in education, health, and infrastructure: An international benchmarking exercise*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3249289

Herrera, S., & Pang, G. (2005). *Efficiency of public spending in developing countries: An efficiency frontier approach* (Vol. 3645). World Bank Publications.

Herrmann, P., Tausch, A., Heshmati, A., & Bajalan, C. S. (2008). *Efficiency and effectiveness of social spending*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1136283

Humphrey, T. M. (1997). Algebraic production functions and their uses before Cobb- Douglas. *Federal Reserve Bank of Richmond Economic Quarterly*, *83*(1), 51–83. http://ideas.repec.org/a/fip/fedreq/y1997iwinp51-83.html

Kabongo, W. N. S., & Mbonigaba, J. (2024). Public health spending in Sub-Saharan Africa: Exploring transmission mechanisms using the latent growth curve mediation model. *Health Economics Review*, *14*(14), 1–17. https://doi.org/10.1186/s13561-023-00472-5

Kabubo-Mariara, J., Ndenge, G., & Mwabu, D. K. (2009). Determinants of children's nutritional status in Kenya: Evidence from demographic and health surveys. *Journal of African Economies*, *18*(3), 363–387.

Kirigia, J. M., Emrouznejad, A., Vaz, R. G., Bastiene, H., & Padayachy, J. (2008). A comparative assessment of performance and productivity of health centres in Seychelles. *International Journal of Productivity and Performance Management*, *57*(1), 72–92. https://doi.org/DOI 10.1108/17410400810841245

Koku, A. (2015). *Efficiency of government expenditure in the ECOWAS Sub-region* [PhD Thesis]. Master thesis, University Of Ghana, Ghana.

Koopmans, T. C. (1951). In *An analysis of production as an efficient combination of activities*. Wiley. https://cir.nii.ac.jp/crid/1572824499992043008

Liu, W., Xia, Y., & Hou, J. (2019). Health expenditure efficiency in rural China using the super-SBM model and the Malmquist productivity index. *International Journal for Equity in Health*, *18*(1), 111. https://doi.org/10.1186/s12939-019-1003-5

Loikkanen, H., & Susiluoto, I. (2005). *Cost efficiency of Finnish municipalities in basic service provision 1994-2022* [Mimeo].

Lovell, C. A. K. (1993). Production Frontiers and Productive Efficiency in H. Fried, CAK Lovell and H. Schmidt (eds) The Measurement of Productive Efficiency. Oxford University Press: Oxford.

Mandl, U., Dierx, A., & Ilzkovitz, F. (2008). *The effectiveness and efficiency of public spending*. Directorate General Economic and Financial Affairs (DG ECFIN), European …. https://ideas.repec.org/p/euf/ecopap/0301.html

Martins, S., & Veiga, F. J. (2014). Government size, composition of public expenditure, and economic development | International Tax and Public Finance. *International Tax and Public Finance*, *21*, 578–597. https://doi.org/10.1007/s10797-014-9313-4

Mcintyre, D., Meheus, F., & Røttingen, J.-A. (2017). What level of domestic government health expenditure should we aspire to for universal health coverage? *Health Economics, Policy and Law*, *12*(2), 125–137.

Mohanty, R. K., & Bhanumurthy, N. R. (2018). *Assessing public expenditure efficiency at Indian states*. https://www.nipfp.org.in/media/medialibrary/2018/03/WP_2018_225.pdf

Novignon, J. (2015). *On the efficiency of public health expenditure in Sub-Saharan Africa: Does corruption and quality of public institutions matter?* https://mpra.ub.uni-muenchen.de/id/eprint/39195

Novignon, J., & Lawanson, A. O. (2017). Health expenditure and child health outcomes in Sub-Saharan Africa. *African Review of Economics and Finance*, *9*(1), 96–121. https://www.ajol.info/index.php/aref/article/view/162145

Ohikhuare, O., Oyewole, O., & Adedeji, A. (2022). Public Health Investment, Human Capital Accumulation, and Labour Productivity: Evidence from West Africa. *Zagreb International Review of Economics & Business*, *25*(2), 139–163. https://hrcak.srce.hr/286092

Olanubi, S. O., & Olanubi, O. E. (2023). 19. Political short termism and government spending efficiency in Sub-Saharan Africa1. *Handbook on Public Sector Efficiency*, 430. https://ddd.uab.cat/pub/caplli/2023/ea12526bad29/AFONSO_9781839109157_2P.pdf#page=438

Olanubi, S. O., & Osode, O. E. (2017). The efficiency of government spending on health: A comparison of different administrations in Nigeria. *Journal of Policy Modeling*, *39*(1), 79–98. https://www.sciencedirect.com/science/article/pii/S0161893816301016

Ouertani, M. N., Naifar, N., & Ben Haddad, H. (2018). Assessing government spending efficiency and explaining inefficiency scores: DEA-bootstrap analysis in the case of Saudi Arabia. *Cogent Economics & Finance*, *6*(1), 1493666. https://doi.org/10.1080/23322039.2018.1493666

Pappas, P., & DePuy, V. (2004). *An overview of non-parametric tests in SAS: When, why and how*. Duke Clinical Research Institute.

Prasetyo, A. D., & Zuhdi, U. (2013). The government expenditure efficiency towards the human development. *Procedia Economics and Finance*, *5*, 615–622. https://www.sciencedirect.com/science/article/pii/S2212567113000725

 JJSS Volume 2, Number 1 (May, 2025)

Productivity Commission PC. (2013). *On efficiency and effectiveness: Some definitions. Productivity CommissionStaff Research Note -.* https://www.pc.gov.au/research/supporting/efficiency-effectiveness

Puspitasari, E. D., & Pujiati, A. (2017). Analysis of efficiency of government expenditure in health sector in Central Java Province in 2012-2014. *Economics Development Analysis Journal*, *6*(1), 30–39. https://journal.unnes.ac.id/sju/index.php/edaj/article/view/22198

Rajkumar, A. S., & Swaroop, V. (2008). Public spending and outcomes: Does governance matter? *Journal of Development Economics*, *86*(1), 96–111. https://www.sciencedirect.com/science/article/pii/S0304387807000697

Sarri, S. (2011). *Production and Productivity as Sources of Well-Being*. MIDO. http://www.mido.fi/Index_tiedostot/Artikkeli%202011.htm

Shephard, R. W. (2015). *Theory of Cost and Production Functions -*. Princeton University Press. https://muse.jhu.edu/pub/267/monograph/book/39766

Sikayena, I., Bentum-Ennin, I., Andoh, F. K., & Asravor, R. (2022). Full article: Efficiency of public spending on human capital in Africa. *Cogent Economics & Finance*, *10*(1), 1–15. https://doi.org/10.1080/23322039.2022.2140905

Silles, M. (2009). The causal effect of education on health: Evidence from the United Kingdom. *Economics of Education Review*, *28*(1), 122–128.

Simar, L., & Wilson, P. W. (2007). Estimation and inference in two-stage, semi-parametric models of production processes. *Journal of Econometrics*, *136*(1), 31–64. https://doi.org/10.1016/j.jeconom.2005.07.009

Stiefel, M. C., Perla, R. J., & Zell, B. L. (2010). A healthy bottom line: Healthy life expectancy as an outcome measure for health improvement efforts. *Milbank Quarterly*, *88*(1), 30–53.

Streeten, P. (1994). Human development: Means and ends. *The American Economic Review*, *84*(2), 232–237. https://www.jstor.org/stable/2117835

The Joint United Nations Programme on HIV/AIDS (UNAIDS). (2022). *Global AIDS update*. : https://www.unaids.org/en/resources/documents/2022/in-danger-globalaids-

Wandeda, D. O. (2021a). *Government Expenditure, Efficiency, Institutional Quality and Economic Growth in Sub-saharan African Countries* [PhD Thesis, University of Nairobi]. http://erepository.uonbi.ac.ke/handle/11295/157221

Wandeda, D. O. (2021b). *Government Expenditure, Efficiency, Institutional Quality and Economic Growth in Sub-saharan African Countries* [PhD Thesis, University of Nairobi]. http://erepository.uonbi.ac.ke/handle/11295/157221

JJSS Volume 2, Number 1 (May, 2025)

Wang, M., & Tao, C. (2019). Research on the efficiency of local government health expenditure in China and its spatial spillover effect. *Sustainability*, *11*(9), 2469. https://www.mdpi.com/2071-1050/11/9/2469

WDI. (2023). *World development indicators* [dataset]. https://databank.worldbank.org/source/world-development-indicators

Wicksteed, P. (1894). *An Essay on the Co-ordination of the Laws of Distribution*. Macmillan & Co. http://cepa.newschool.edu/het/texts/wicksteed/wickess.pdf

Widner, J. (2015). Human development in Africa. *Perspectives on Politics*, *3*(3), 572–575.

Workie, N. W., Shroff, E., Yazbeck, A. S., Nguyen, S. N., & Karamagi, H. (2018). Who needs big health sector reforms anyway? Seychelles' road to UHC provides lessons for Sub-Saharan Africa and Island Nations. *Health Systems & Reform*, *4*(4), 362–371. https://doi.org/DOI: 10.1080/23288604.2018.1513265

World Health Organization WHO. (2018). *Seychelles: Country cooperation strategy*. http:// www.who.int/countries/en/

World Health Organization WHO. (2019). *Cabo Verde shows us the healthcare progress we want to see across Africa*. https://www.afro.who.int/news/cabo-verde-shows-us-health-care-progress-we-want-to-see-across-africa

World Health Organization WHO. (2022). *Obesity rising in Africa: WHO analysis finds*. https://www.afro.who.int/news/obesityrising- africa-who-analysis-finds

World Health Organization WHO. (2023). *World malaria report* (Tracking Progress and Gaps in the Global Response to Malaria). https://www.who.int/tems/global-malaria-report

World Health Organization WHO. (2024a). *Health data overview for the Republic of Cabo Verde* [dataset]. https://data.who.int/countries/132

World Health Organization WHO. (2024b). *Health data overview for the Republic of Seychelles* [dataset]. https://data.who.int/countries/69

World Health Organization WHO. (2024c). *WHO certifies Cabo Verde as malaria-free, marking a historic milestone in the fight against malaria*. https://www.who.int/news/item/12-01-2024-who-

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